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GEOLOGICAL SURVEY OF CANADA | COMMISSION GÉOLOGIQUE DU CANADA

DESCRIPTIVE NOTES

This map shows the complex transition from a region of amphibolite-facies gneisses derived from the Archean Nain Province and an intrusive suite of Paleoproterozoic meta-plutonic rocks in the east, to the predominantly Paleoproterozoic metasedimentary and metaplutonic rocks at the western edge of the map sheet. Exposure of outcrop is excellent across the south and western parts of the map area, but tapers off to the north and northeast, where the Eclipse River valley carves out a broad sandy plain at 200-300' elevations, and disappears under the waters of Lac Lemoyne. High elevations vary from 3100' in the southeast, to 2720' in the southwest, to a limited plateau at 2020' in the northwest. Caribou are common in the river valleys, where indications of native habitation may be found. The map area was accessed entirely by helicopter-supported ground traversals from a basecamp located 6 km east of the map area.

Lithology

Migmatitic tonalitic orthogneisses **[Argn]** of suspected Archean age occur throughout the eastern one-third to one-half of the map area. These rocks, all Paleoproterozoic amphibolite facies with relics of Archean granulite-facies mineralogy, contain multiple phases of granitic veins which define a gneissosity together with a cm-dm scale compositional heterogeneity derived from a variety of compositional intrusive (?) phases and multiple, strongly deformed and highly attenuated inclusions of mafic to ultramafic rocks too small to be shown on map), ultramafic **[Aum]** and anorthositic rocks **[Aan]**, and rare slivers of biotite-garnet ± sillimanite paragneiss **[Ams]**. Inclusions generally contain a gneissic fabric, which, in mafic rocks, is often preserved as a relict through to that in host tonalitic gneisses. These rocks are interpreted to represent the western continuation of Archean rocks derived from Nain Province protoliths.

The tonalitic gneisses contain folded, and often discontinuous layers of amphibolite, which are locally seen to be discordant to the gneissosity in the host rocks and are therefore interpreted to represent a set of mafic dykes. The dykes contain a D_{n+1} fabric which, although commonly folded, is of a much simpler nature than the migmatitic gneissosity preserved in mafic inclusions within the tonalite gneiss that are interpreted to be of Archean age, so that the dykes are interpreted to Paleoproterozoic in age and to represent the western, amphibolite-facies equivalents of the undeformed, granulite-facies Ayaulik dykes which cut Archean gneisses of the Nain Province along the Labrador Sea coast (Wardle et al., 1992).

Migmatitic tonalitic orthogneisses of suspected Archean age also occur within the western part of the map area, where they are metamorphosed to Paleoproterozoic granulite facies **[APgl]** and variably retrogressed amphibolite facies **[Argn, Argn]**. Like their eastern, lower-grade equivalents, these rocks also contain numerous inclusions of ultramafic through anorthositic rocks, and contain folded layers and disrupted pods of medium-grained, locally garnetiferous granites (2 m wide, too small to show on map) which locally cut the migmatitic fabrics in the tonalitic gneisses and are therefore interpreted to represent recrystallized mafic dykes. It is not certain if these polycyclic gneisses were derived from Nain Province protoliths, or represent slivers derived from some other crustal block.

The migmatitic tonalitic orthogneisses of suspected Archean age in the western part of the map area are locally to extensively transformed into diatexitic migmatites **[Pmtg]**, containing variably homogenized to equigranular, wispy-textured rocks of tonalitic to granodioritic composition **[Pgd]**, containing layers and lenses of mafic (and locally anorthositic) granulite derived from remnant inclusions and dykes. The homogenization of the tonalitic gneisses is also derived through assimilation of the Archean gneisses by widespread infusion of younger magmas, or through in situ partial melting of the older rocks during high-grade metamorphism. The homogeneous rocks have an identical appearance to parts of the Kiliness charnockitic suite to the north of the map area (see inset map; Van Kranendonk et al., 1992), except that the former contain a greater proportion of mafic inclusions.

In the southeastern part of the map area, Archean Nain gneisses are locally in tectonic contact with thin, continuous units of layered mafic gneiss **[Pamg]**, and both of these units are intruded by grey- to white-weathering, foliated Paleoproterozoic granitic gneisses **[Pgg]** (2.0 Ga; Scott et al., 1993). The layered mafic gneisses are characterized by a cm- to dm-scale layering that is defined by modal variations in hornblende, hornblende, clinopyroxene, and plagioclase. Local occurrences of thin metasedimentary units suggests that the layered mafic gneisses represent a supracrustal succession of volcanic or volcaniclastic rocks: layers with relict gabbroic texture and others with homogeneous, uniform composition, suggest the presence of subvolcanic intrusions.

Homogeneous, foliated metaplutonic rocks of the DTG suite **[PdDTG]** (Van Kranendonk et al., 1993) are dominantly tonalitic-granodioritic in composition in the map area and are distinctly more homogeneous than the migmatitic Archean orthogneisses. DTG suite rocks and the layered mafic gneisses contain a simpler fabric than their Archean counterparts, and do not contain mafic dykes, suggesting a Paleoproterozoic age for these units. This is confirmed by U-Pb zircon data on DTG suite samples collected from outside of the map area, which indicate ages of between 1910-1885 Ma (Scott et al., 1993; Scott, and Machado, 1994).

The rocks of suspected Archean age in the western part of the map area are in sharp tectonic contact with adjacent paragneisses across narrow belts that contain a mixture of ultramafic **[Pumt]** and mafic **[Pdd]** gneisses, graphitic and Fe-rich quartzites, impure marble, and rusty-weathering paragneisses with lilac-coloured garnets **[Psdx]**. This zone varies from 1-300 m in width, and many of rock types within the zone are not found outside of it. Except for the rusty-weathering paragneisses, the units within the contact zone are discontinuous, and are commonly folded with the gneissosity in the migmatitic orthogneisses. These features suggest that the contact zones represent thrust faults (see below). Significantly, in areas where Archean protoliths can be recognized, the homogeneous rocks of unit **Pgd** do not occur across this boundary zone, suggesting that intrusion or partial melting occurred before thrust deformation.

Migmatitic, biotite paragneisses **[Ppgg]** of Paleoproterozoic age in the western part of the map area are locally garnetiferous, and are dark- to brown-weathering surface, abundant leucosome veins, and red garnets; sillimanite is rare. In contrast to the grey- to brown-weathering paragneisses with lilac-coloured garnets and abundant sillimanite, known as the Tasiuyak gneisses (Taylor, 1979). The Tasiuyak gneiss is typically homogeneous on a large scale and does not contain the various other supracrustal rocks that are found in the paragneisses denoted by **Psgg**. Both units may contain graphite. The contact between these units is typically sharp, and rarely marked by mylonite.

Within the paragneisses are bodies of white-weathering, garnetiferous granite **[Psdx]** which contain numerous schlieren and inclusions of paragneiss. The granites have all the characteristics of anatectic paragneiss, and veins and dots of similar mobile material may be found in paragneiss across the map area, comprising up to 40% of some outcrops. The granites are interpreted as dislikeites derived from partial melting of the paragneisses.

Black-weathering quartz diorite bodies with a colour index of 25-30% (orthopyroxene - hornblende ± biotite) underlie a large part of the western part of the map area. In contrast to the homogeneous tonalite-granite suite **[Pdgr]** and the paragneisses, these rocks contain a simple fabric and lack a migmatitic character, locally show intrusive contact relationships with adjacent metasedimentary rocks, and rarely contain inclusions or xenoliths of fine-grained diorite. A sample from the Big Island pluton (map area 24P/7; Van Kranendonk, 1993) was dated by the U-Pb method on zircon, as 1895 ± 2 Ma (Scott and Machado, 1994).

Significantly, all units interpreted to be Paleoproterozoic in age, or dated as such, do not contain mafic dykes. This observation indicates that the metamorphosed mafic dykes in Archean rock dykes are older than ca. 1910 Ma, but younger than the Archean rocks (ca. 2560 Ma: D. Scott, pers. comm., 1994).

All units of the map area are cut by a set of undeformed, brown-weathering mafic dykes, which contain fine diabasic to coarse-gabbroic textures, but that are not plagioclase phyric **[Dd]**. These dykes are thought to be Cambrian in age on the basis of a K-Ar age of 524 ± 78 Ma on a dyke from north of the present map area (NTS 24P/15: Wanless et al., 1970).

Structure and Metamorphism

Migmatitic planar fabric elements within rocks of suspected Archean age (**Argn, Agn, APgl**), that are cut by mafic dykes, are of suspected Archean age and are denoted as D_n. Neither these structures, nor the dykes which cut them, have been recognized outside of these units.

Structures of interpreted Paleoproterozoic age occur throughout the map area and affect those of suspected Archean age in the migmatitic tonalitic gneisses. The earliest set of Paleoproterozoic structures (D_{n+1}) include a migmatitic gneissosity in paragneisses and a foliation in metaplutonic rocks (collectively referred to as S_{n+1}) and tight to isoclinal folds within the contact zone between migmatitic tonalitic gneisses (**APgl**) of suspected Archean age and Paleoproterozoic paragneisses (**Ppgg**) is also interpreted as belonging to this generation of structures, as the zone is axial planar to a regional, ductile thrusting and shearing event, D_{n+1}. If the tonalitic rocks (**Pgd**), which homologize the migmatitic tonalitic gneisses (**APgl**) are similar in age to the rocks of the Kiliness charnockitic suite (1895 ± 3 Ma: Scott et al., 1993), then thrusting post-dated this time, as such rocks have not been found across the boundary between Archean rocks and the paragneisses. Isoclinal folding of compositional layering in paragneisses (transposed bedding) are probably also the result of D_{n+1} deformation.

Upright, to steeply inclined folds (F_{n+2}) of migmatitic gneissosity and foliations (S_{n+2}) occur in all units across the map area, and belong to the D_{n+2} set of structures. A large-scale D_{n+2} synform folds Tasiuyak paragneiss (**PsTg**) and quartz diorite (**Pqd**) in the south-central part of the map area. Axial planar foliations are commonly associated with fold closures, and a regionally-developed, NW-SE striking, steeply-dipping foliation is defined across the map area. Accompanying the development of D_{n+2} foliations is a prominent NW-plunging mineral elongation lineation (L_{n+2}) which is most commonly defined by quartz, but also by orthopyroxene, hornblende, and sillimanite.

D_{n+2} fabric elements die out from the western granulite-facies domain to the eastern, amphibolite-facies domain, which is dominated by shallow W-plunging F_{n+2} folds of S_{n+2} gneissosity and the L_{n+2} lineations defined by quartz and hornblende. These structures gradually overprint the D_{n+1} fabric elements and are associated with the retrogression of granulite facies assemblages M_{n+1} to amphibolite-facies M_{n+2} assemblages. N-S and NNE-SSW trending, open to tight folds in the central part of the map area are interpreted to be F_{n+3} structures, locally tightened up and partly re-oriented by a subsequent, sinistral shear zone along the amphibolite- facies/granulite-facies transition. Late, brittle faults, commonly with pseudotachylite-bearing breccia, are believed to represent a fourth generation of Paleoproterozoic structures (D_{n+4}), and these are also concentrated along the retrograde granulite-facies metamorphic isograd.

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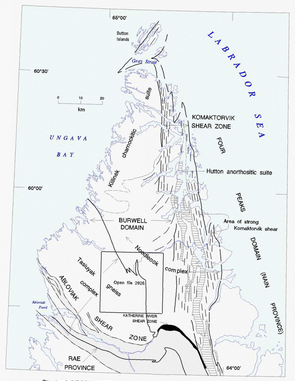
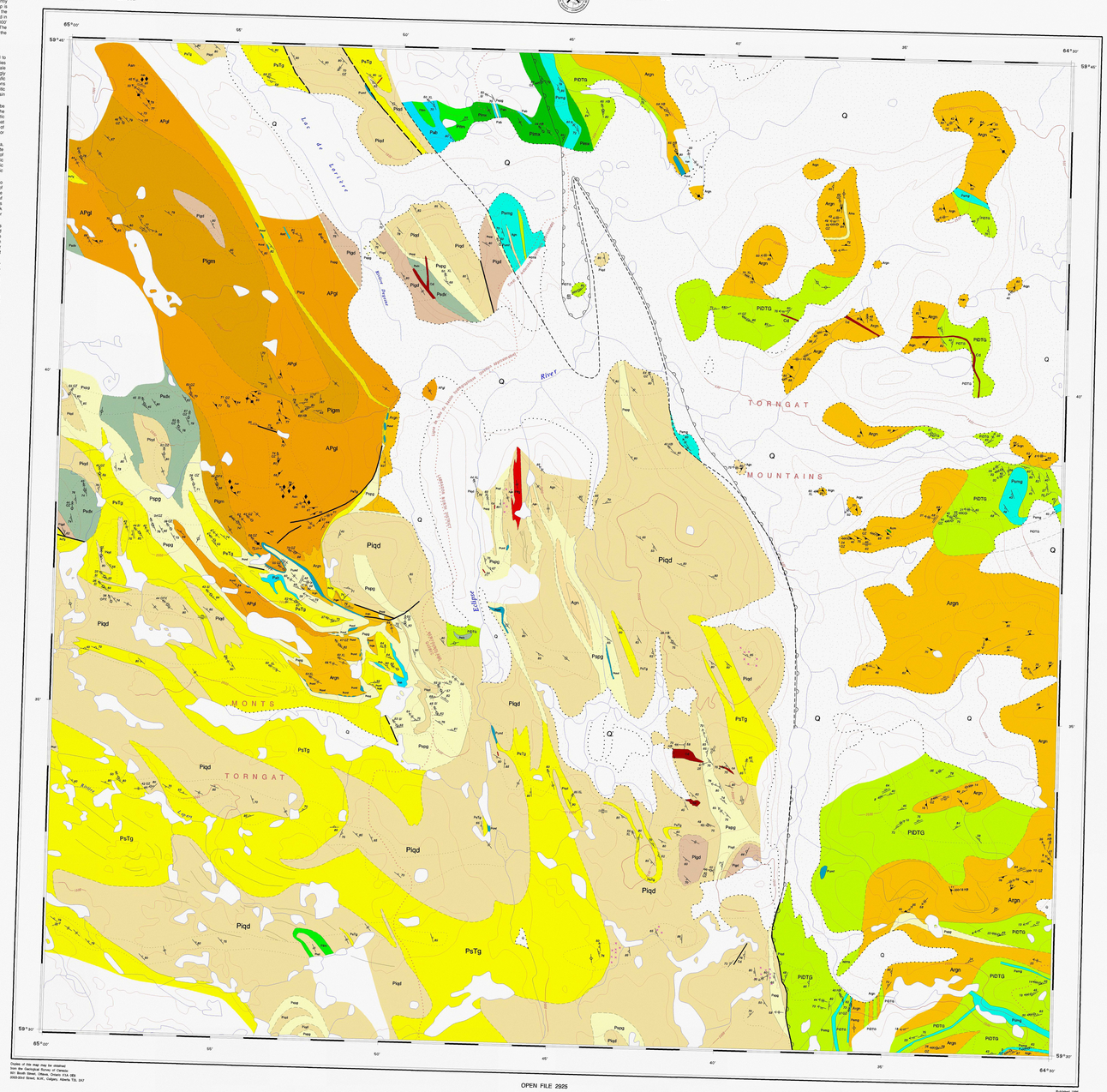


Structural (UPPER CASE) and lithological (lower case) subdivisions of the northern part of the Paleoproterozoic Torngat Orogen, Labrador, Québec and Northwest Territories (after Van Kranendonk et al., 1992).
Location of map area outlined by square box.



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GEOLOGY

LAC DE LORIÈRE

NEWFOUNDLAND (LABRADOR) - QUÉBEC

Scale 1:50 000 - Echelle 1/50 000

Kilometres 1 0 1 2 3 4 Kilometres

Transverse Mercator Projection
OM 64°45', Scale Factor 1.0
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Projection transverse de Mercator
M.O. 64°45', facteur d'échelle 1,0
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24 P/14	24 P/15	24 P/16
24 P/11 OF 3829	24 P/12 OF 3826	24 P/9 OF 3826
24 P/8	24 P/7 OF 2738	24 P/5 OF 3828

NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND INDEX
TO COVERAGE BY GEOLOGICAL SURVEY OF CANADA MAPS
SYSTÈME NATIONAL DE RÉPÉRAGE CARTOGRAPHIQUE
ET INDEX DES COUVERTURES DES CARTES DE LA
COMMISSION GÉOLOGIQUE DU CANADA

LEGEND

ARCHEAN ROCKS

Nain Province

- **Agn** — *Unsubdivided tonalite-granodiorite orthogneiss and migmatite, with highly variable composition and texture; typically complex, very well-layered and heterogenous migmatitic with < 50% of inclusions of mafic gneiss (**Amf**), anorthositic gneiss (**Aan**) and metasedimentary gneiss (**Ams**), varies to homogeneous, foliated metaplutonic rock; with < 10-20% inclusions of mafic dykes and supracrustal gneisses. Metamorphosed under Late Archean granulite-facies orthopyroxene), and out by Ayaulik dykes, and affected by a Paleoproterozoic amphibolite-facies overprint*
- **Argn** — *As* **Agn** *above, but fully retrogressed to Paleoproterozoic amphibolite-facies mineral assemblages*
- **APgl** — *Tonalite-granodiorite orthogneiss and migmatite, with inclusions and layers of mafic granulite and meta-anorthosite, and recrystallized mafic dykes; at Paleoproterozoic granulite-facies.Veined by Paleoproterozoic leucosome (***Pgd***); grades into* **Pgm**
- **Ams** — *Metasedimentary gneisses: predominantly rusty brown weathering garnet-biotite ± sillimanite paragneiss and metapelite, but also with rare, thin layers of garnetiferous gneiss from formation, impure marble, and quartzo-feldspathic gneiss of unknown derivation*
- **Amf** — *Equigranular, homogeneous to layered mafic gneiss of unknown derivation; locally with plagioclase megacrysts*
- **Aum** — *Ultramafic rocks; tan coloured meta-dunite or dark brown pyroxenite*
- **Aan** — *Purple to grey, garnetiferous (<40%), granoblastic meta-anorthosite, layered anorthositic gabbro and metagabbro; as sheets or discordant trains of lectonic inclusions. Other than local compositional layering, igneous textures and mineralogy are not preserved in the thoroughly recrystallized, granulite-facies rocks which were intruded by the surrounding Archean tonalite gneiss (***Argn***) and that experienced Late Archean deformation*

PALEOPROTEROZOIC ROCKS

META-PLUTONIC ROCKS

- **Pdgr** — *Dykes and veins of pegmatitic granite. Density of veining reflected by density of crosses*
- **Pdg** — *Sugary-textured fine- to medium-grained, pink and grey granite; foliated to gneissic*
- **Pitm** — *Clinopyroxene-orthopyroxene-hornblende-plagioclase gneiss; in marginal facies, is well layered to migmatitic*
- **PdDTG** — *Polyphase intrusive suite, varying from mafic diorite, through tonalite and granodiorite, to granite and quartz monzodiorite; at amphibolite facies. Dominantly (>80%) homogeneous, leucocratic tonalite to quartz diorite (hornblende-biotite ± epidote), with inclusions of plagioclase-phyric diorite and metagabbro, and layered mafic gabbro-diorite sheets cut by porphyritic gabbro sheets and numerous sheets of leucocratic granite and pegmatitic granite. Textures vary from weakly-foliated meta-plutonic rocks to migmatitic orthogneisses with local complex bootleg folding; intrusive into Archean Nain gneisses (***Argn***), (***Agn***), (***Agl***)*
- **Pitmx** — *Well-layered 'zebra gneiss'; consisting of alternating black hornblende-rich layers and white plagioclase+quartz-rich layers on 5-30 cm scale*
- **Pigd** — *Grey- to black-weathering melanocratic quartz diorite (colour index = 20-30%) at granulite-facies (orthopyroxene-hornblende-biotite); commonly with relic igneous plagioclase and cognate xenoliths of fine-grained diorite/quartz diorite. Dated by U-Pb on zircon as 1895 ± 2 Ma (Scott and Machado,1994, in map area 24P/8)*
- **Pgd** — *Massive to foliated, leucocratic, orthopyroxene-bearing granitoid rocks. Dominantly buff-weathering, medium-grained, subgranular granodiorite. Sample from McLean Trought (NTS 25E /10) dated by U-Pb on zircon as 1895 ± 3 Ma (Scott et al., 1993), and one from NTS 25A/2 as 1886 ± 4 Ma (Scott and Machado, 1994)*
- **Pgm** — *Leucocratic, medium- to coarse-grained, orthopyroxene bearing granodiorite, with inlayr-layering and mafic granulite inclusions; typically very homogeneous, although amount of mafic granulite inclusions varies from 1-30% of rock. Weathers through whitesaspt, in situ melting of granulite-facies Archean tonalitic orthogneiss (***APgl***) , which locally occurs*
- **Psdx** — *White, medium- to coarse-grained granite with rest to lilac-coloured garnets; contains grey, garnetiferous schlieren (paragneiss rectite) Derived through granulite-facies anatexis of paragneiss (***PsTg*** and ***Ppgg***)*

SUPRACRUSTAL ROCKS

- **Pspg** — *Grey- to buff-weathering paragneiss with red garnet and biotite, abundant leucosome and complex migmatitic character, + pattern denotes layered quartzite/carbonate unit*
- **Psrg** — *Rusty brown and red-weathering, graphite-rich biotite ± garnet paragneiss*
- **PsTg** — *Tasiuyak gneiss; rusty brown and white weathering paragneiss and diatexite, characterized by lilac-coloured garnets and sillimanite. Well layered on a 10cm-2m scale, varying from garnet quartzite to semi-pelitic garnet-biotite-feldspar-quartz gneiss, to pelitic sillimanite-biotite-garnet quartzo-feldspathic gneiss; all cut by and/or interlayered with white garnet granite Padx*
- **Psmg** — *Carbonate-layered mafic gneiss, interlayered with plagioclase-phyric and more homogeneous amphibolites; intruded by Paleoproterozoic diorite and tonalite of the PdDTG suite*
- **Pab** — *Homogeneous, equigranular mafic amphibolite to granulite; layering generally not present*
- **Pumf** — *Massive to foliated, homogeneous to layered pyroxenite (olimpyroxene-hornblende ± anthophyllite)*

Lithological contact (defined, inferred)

Trace of gneissosity from airphoto interpretation

Fault (defined with shear sense where known, inferred)

Limit of visited outcrop

Limit of unconsolidated sedimentary cover + thickness(m)

Lithotectonic assemblage boundary (inferred)

Limit of (M$_{n-1}$) amphibolite-facies retrogression of (M$_{n-2}$) granulite-facies mineral assemblages (teeth on low grade side)

Dykes, inclined (Cd)

Inclusion of meta-anorthosite to gabbro (**Aan**)

Paleoproterozoic fabric elements

D_{n+4} fabric elements: ultramylonites and faults

Brittle fault and ultramylonite, with movement unknown; inclined

D_{n+3} fabric elements: amphibolite facies

Inclined schistosity; no movement sense, sinistral, dextral

Vertical schistosity; no movement sense, sinistral, dextral

Fold axial plane: inclined, vertical

Fold axis: symmetrical, z-asymmetric, z-asymmetric

Lineation: mineral elongation, striping

D_{n+2} fabric elements: granulite facies

Inclined schistosity; no movement sense

Vertical schistosity; no movement sense

Fold axial plane: inclined, vertical

Fold axis: symmetrical, z-asymmetric, z-asymmetric

Lineation: mineral elongation, striping

D_{n+1} fabric elements

Schistosity or gneissosity: inclined, vertical

Archean fabric elements (D_n)

Gneissosity: inclined, vertical

Fold axis: symmetrical

Abbreviations: HB = hornblende, OPX = orthopyroxene, GZ = quartz, Sil = sillimanite, XL = intersection

Geology by M.J. Van Kranendonk, R.J. Wardle, F.C. Mengel, R. Churchill, L.M. Campbell, and S. Schnarr, 1992-1993, Geological Survey of Canada and Newfoundland Dept. of Mines and Energy

Digital map compilation by M.J. Van Kranendonk, Geological Survey of Canada

Digital cartography by N. Grenier, Geological Survey of Canada

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Magnetic declination 1994, 39°51' W, decreasing 17.5' annually

Elevations in feet above mean sea level

COOPERATION

COOPERATION AGREEMENT MINERAL DEVELOPMENT

ENTENTE DE COOPÉRATION SUR L'EXPLOITATION MINÉRALE

Contribution to Canada-Newfoundland Cooperation Agreement on Mineral Development (1990-1994), a subsidiary agreement under the Economic and Regional Development Agreement.

Contribution à l'Entente de coopération Canada-Terre-Neuve sur l'exploitation minérale (1990-1994), entente auxiliaire négociée en vertu de l'Entente Canada/Terre-Neuve de développement économique et régional.

Canada | Newfoundland Terre-Neuve

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